



# Assessment of SW and GW Conditions & Interaction in California's Central Valley Using C2VSim-FG

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Jim Blanke (RMC)

Dan Wendell (TNC)

Complex Challenges | Innovative Solutions

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# Outline

- C2VSim Fine Grid (C2VSim-FG)
- C2VSim-FG Existing Condition Baseline
- Scenario 1: Increased Agricultural Demand
- Scenario 2: Increased Irrigation Efficiency
- Scenario 3: Groundwater Substitution



# C2VSim Fine Grid Development

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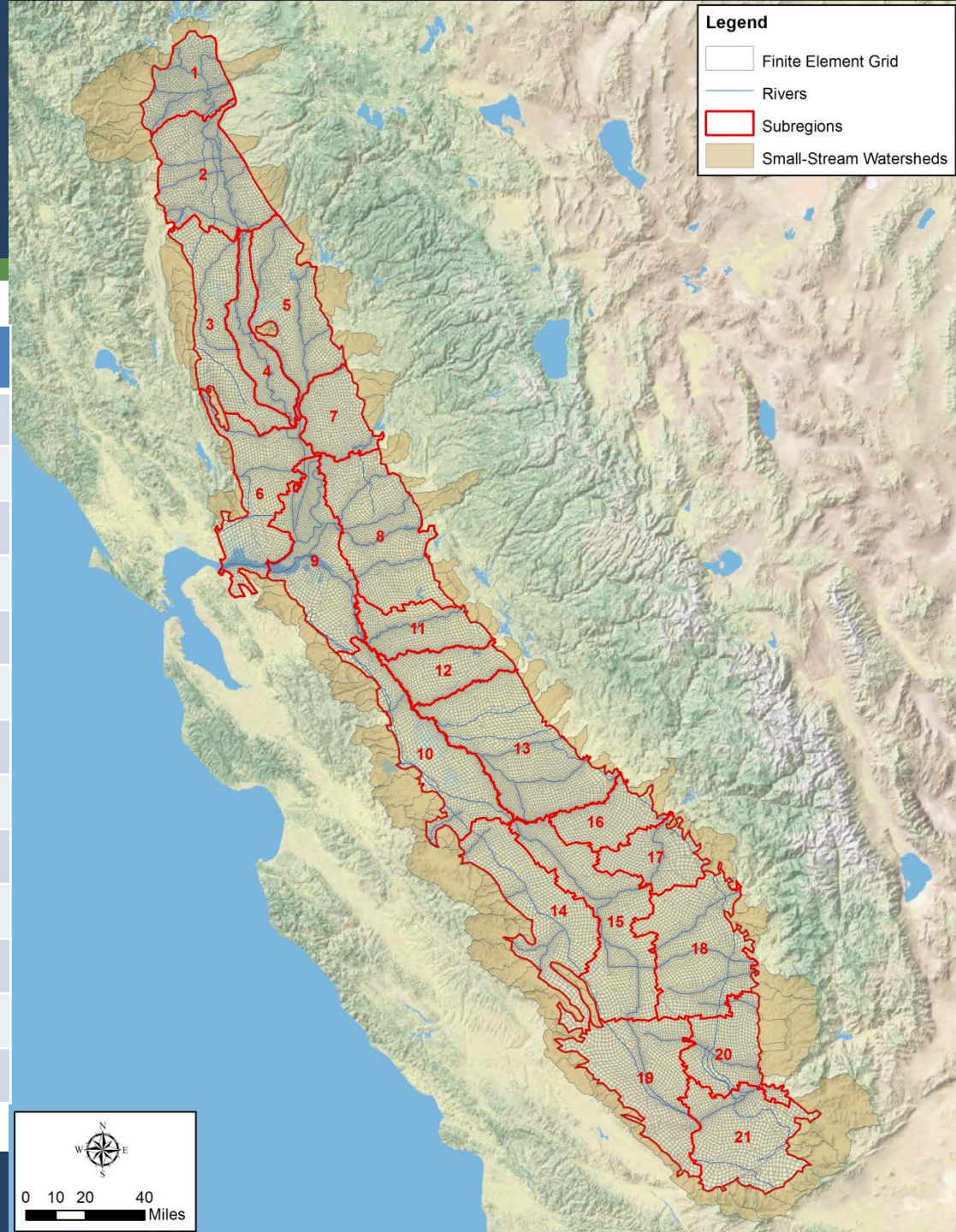
# C2VSim Refinement Objectives

- C2VSIM-CG
  - Successful Application to Numerous Water Resources and Hydrologic Studies
  - Average Element Size of 6 Square Miles
- Future Applications Require Model with More Refined Spatial and Temporal Resolution
  - Calsim Integration
  - Water Portfolio Analysis
  - Water Management Studies
  - Regional and Central Valley Wide Hydrologic Analysis

# C2VSim-FG

## Summary Statistics

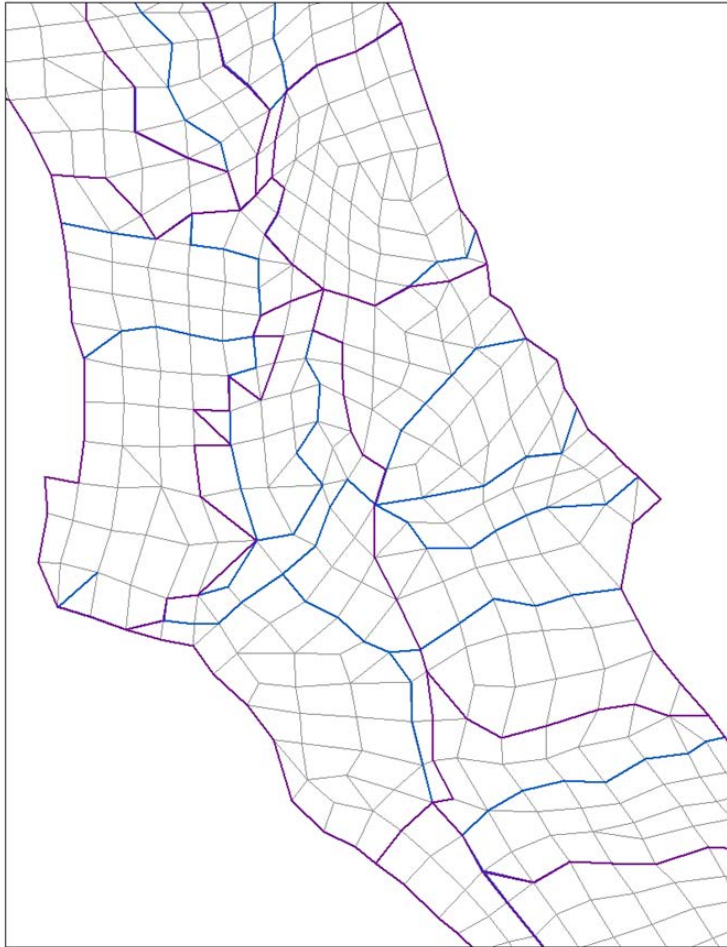
GW Nodes	30,179
Elements	32,537
Min Element Area (Sq. Miles)	0.006
Max Element Area (Sq. Miles)	2.767
Ave Element Area (Sq. Miles)	0.636
Total Model Area (Sq. Miles)	20,742
Stream Nodes	4,529
Stream Reaches	105
Stratigraphic Layers	3
Subregions	21
Small Watersheds	210
Hydrologic Period	1922-2009
Time Step	Monthly



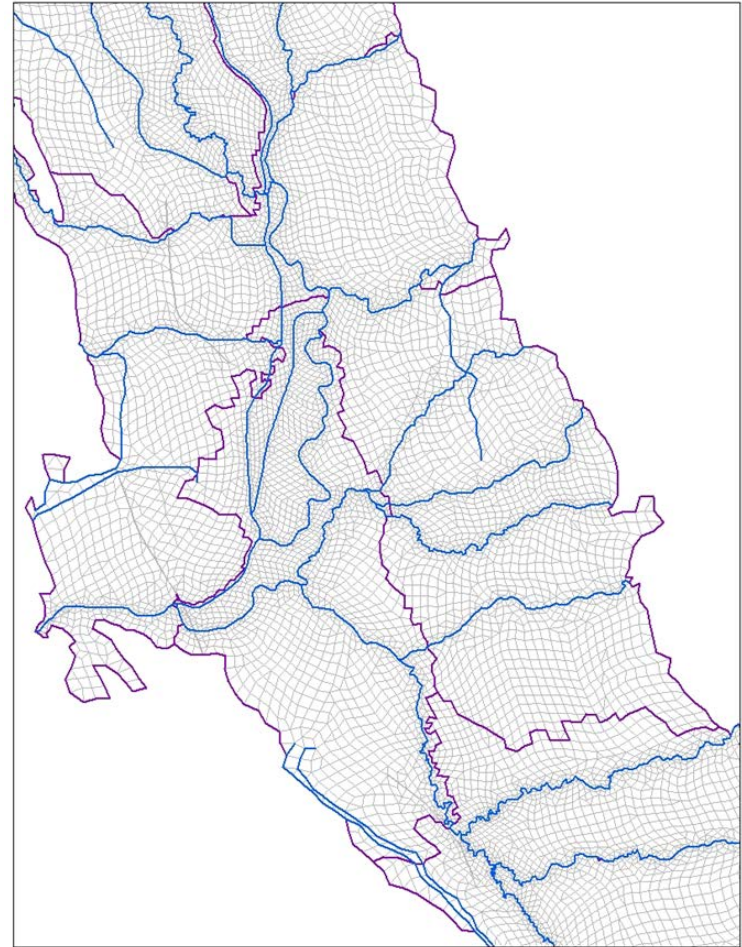


# Butterfield Creek Subcatchment (Detail)

C2VSim Coarse Grid



C2VSim Fine Grid



# Existing Condition

## Baseline Development Assumptions

- Hydrology:** 1973 – 2009 (repeated twice)
- Land Use and Crop Acreages:** 2005 (suggested by DWR)
- Agricultural Demand:** Calculated by C2VSim using the 1973-2009 hydrology and 2005 land use
- Urban Demand :** 2009 level urban demands from the historic model
- SW Supply :** Historical water deliveries from 1973 to 2009
- Pumping:** Calculated by C2VSim (Demand-SW Supply).
- Stream Inflows :** Historical streamflows from 1973 to 2009
- Initial Conditions:** C2VSim Historic Calibration 2009 results.



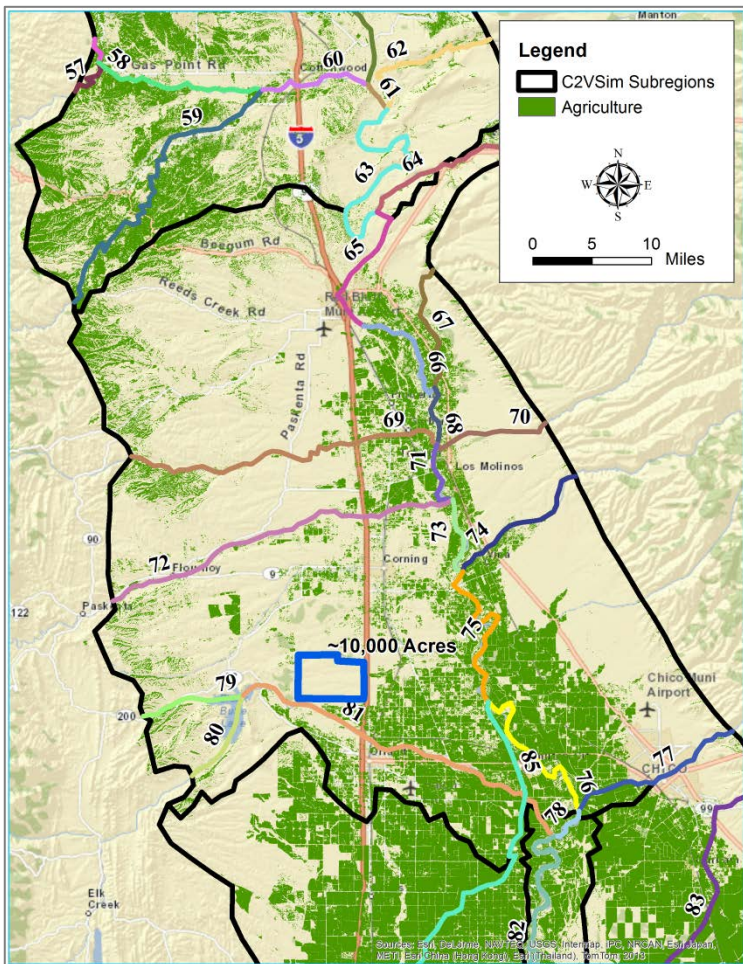
# Scenario 1: Increased Agricultural Demand

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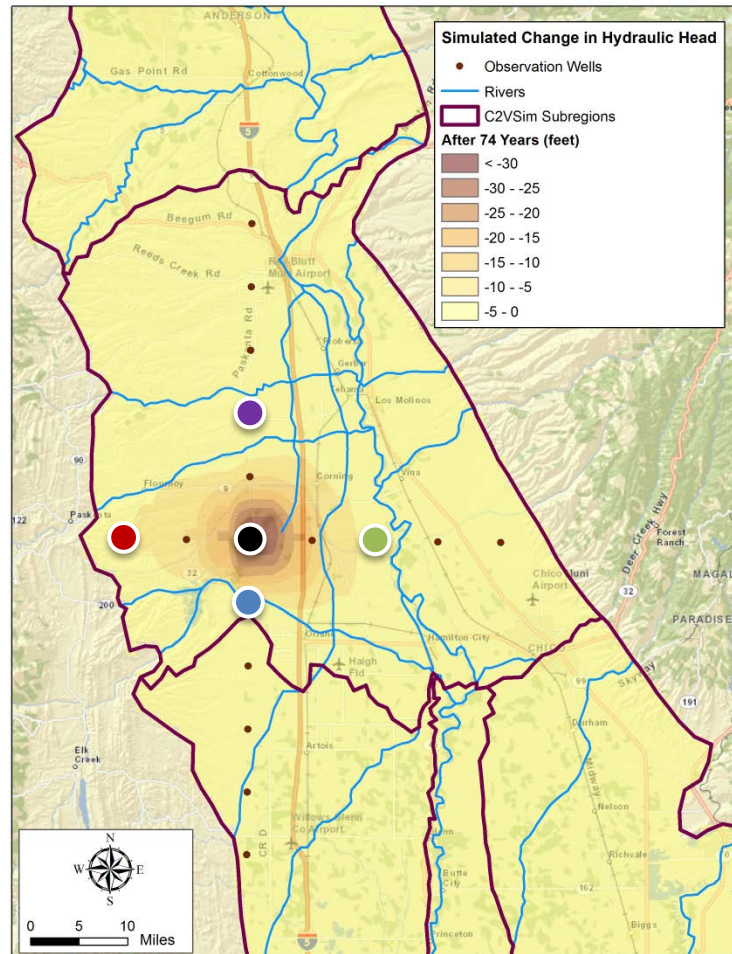


# Assumptions & Location

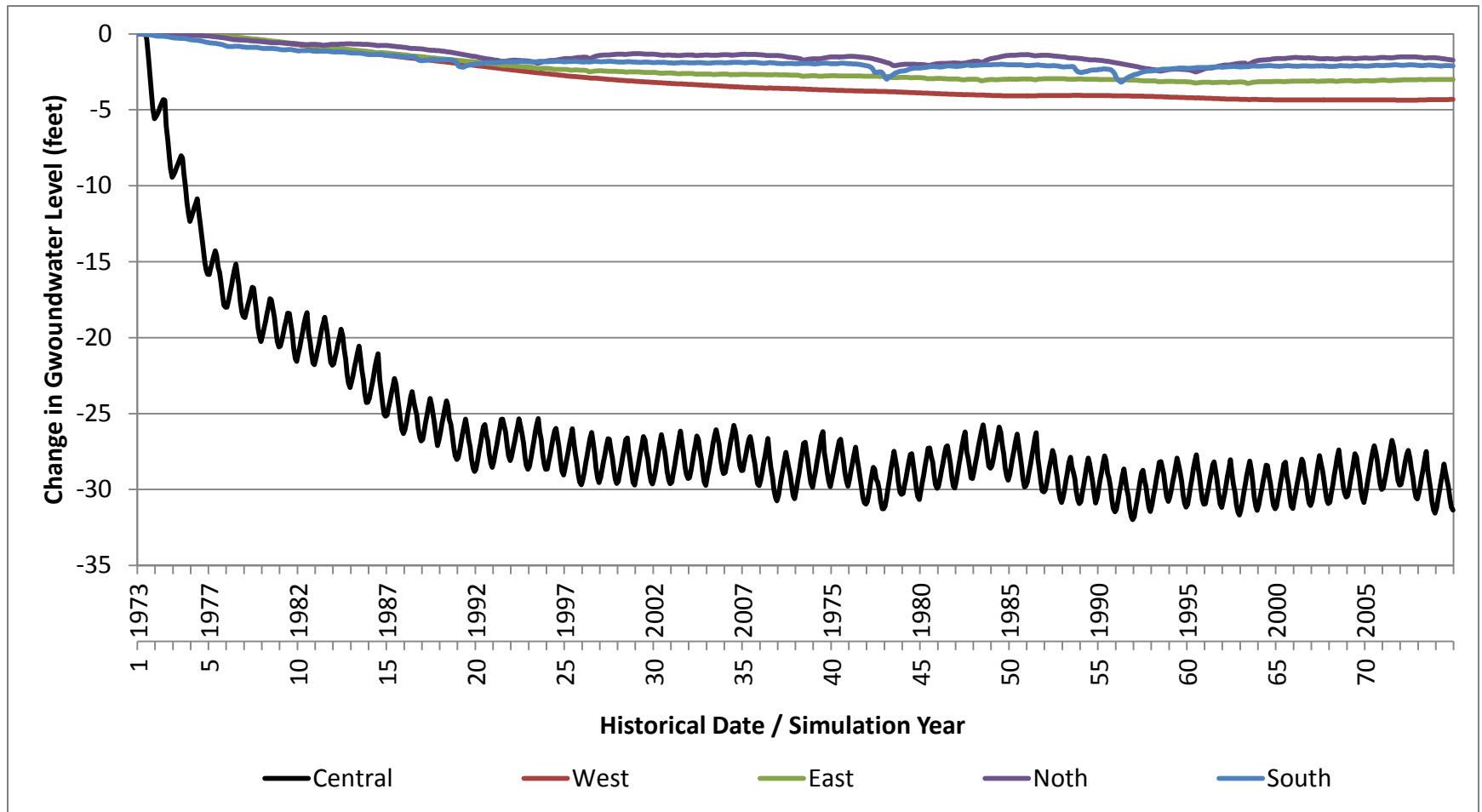


- Converted 10,000 acres of native land to agriculture
- Assigned orchards as the crop type
- Compensated the additional ag demand with pumping
- Distributed the additional pumping between layers 1 and 2

# Groundwater Level Analysis

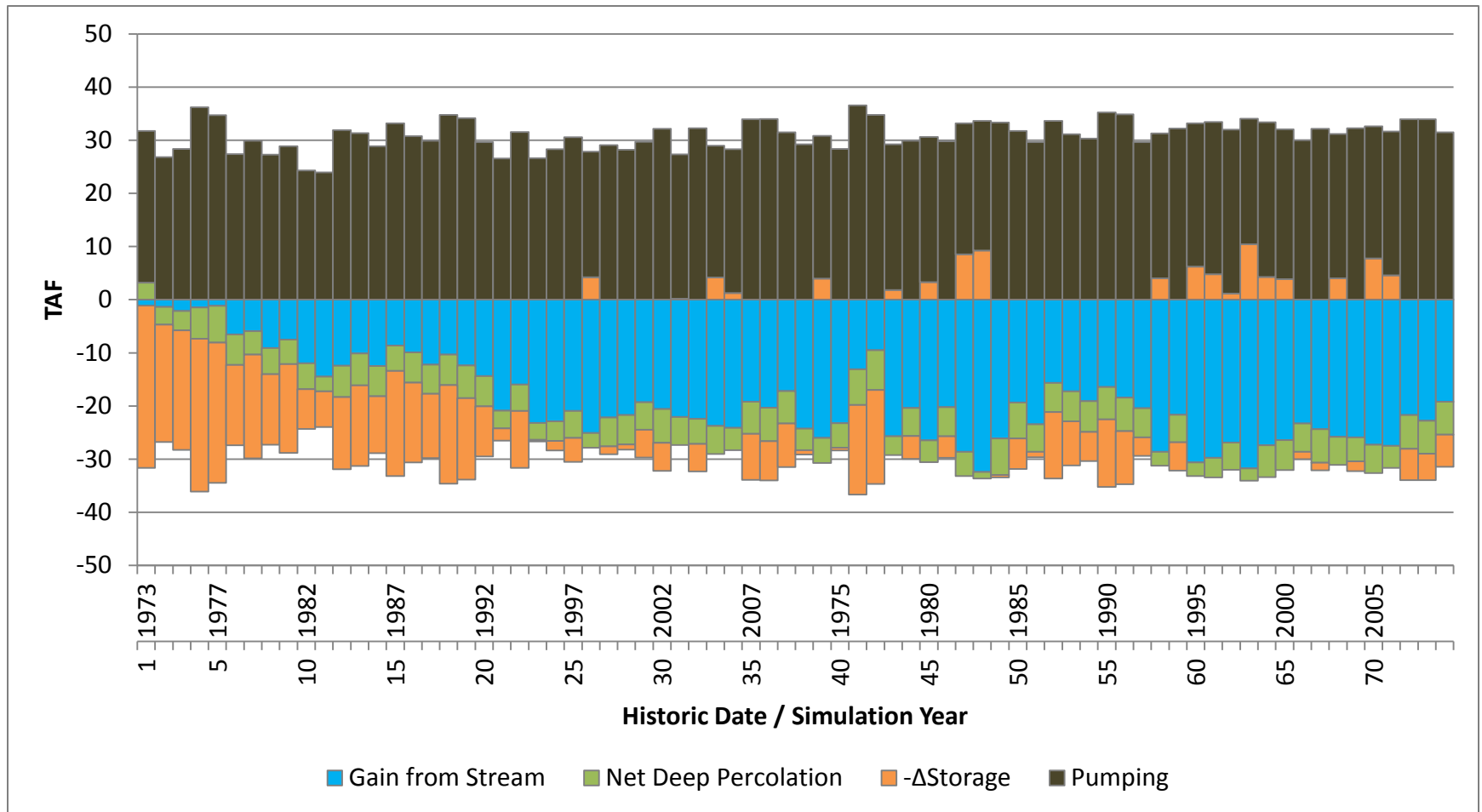


# Groundwater Level Analysis



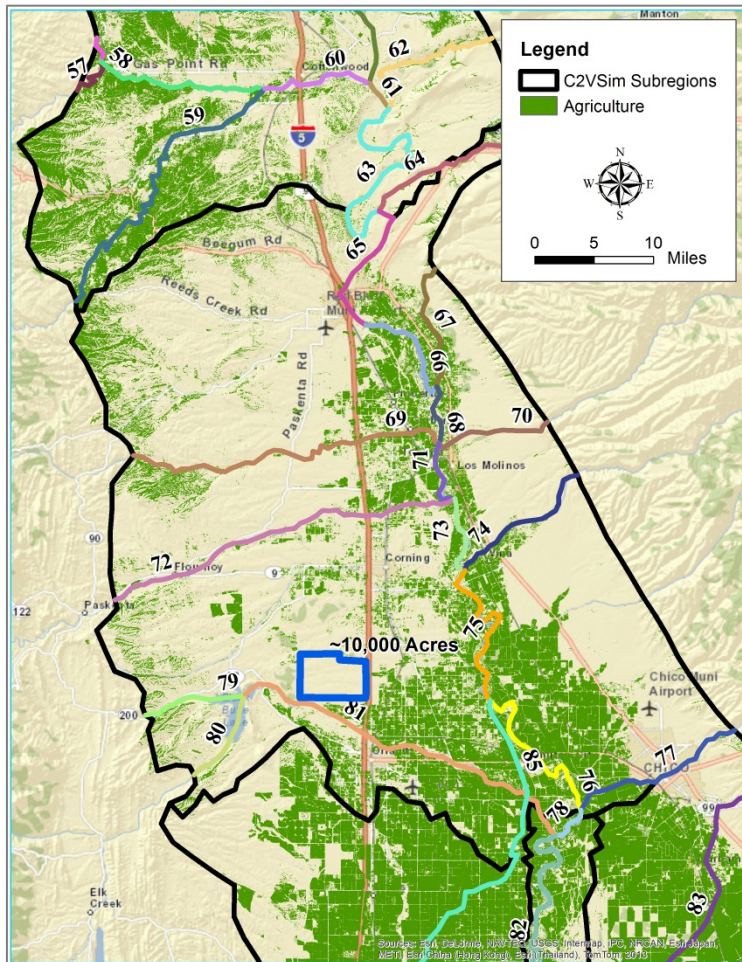
# Change in Groundwater Budget

(Scenario – Baseline)





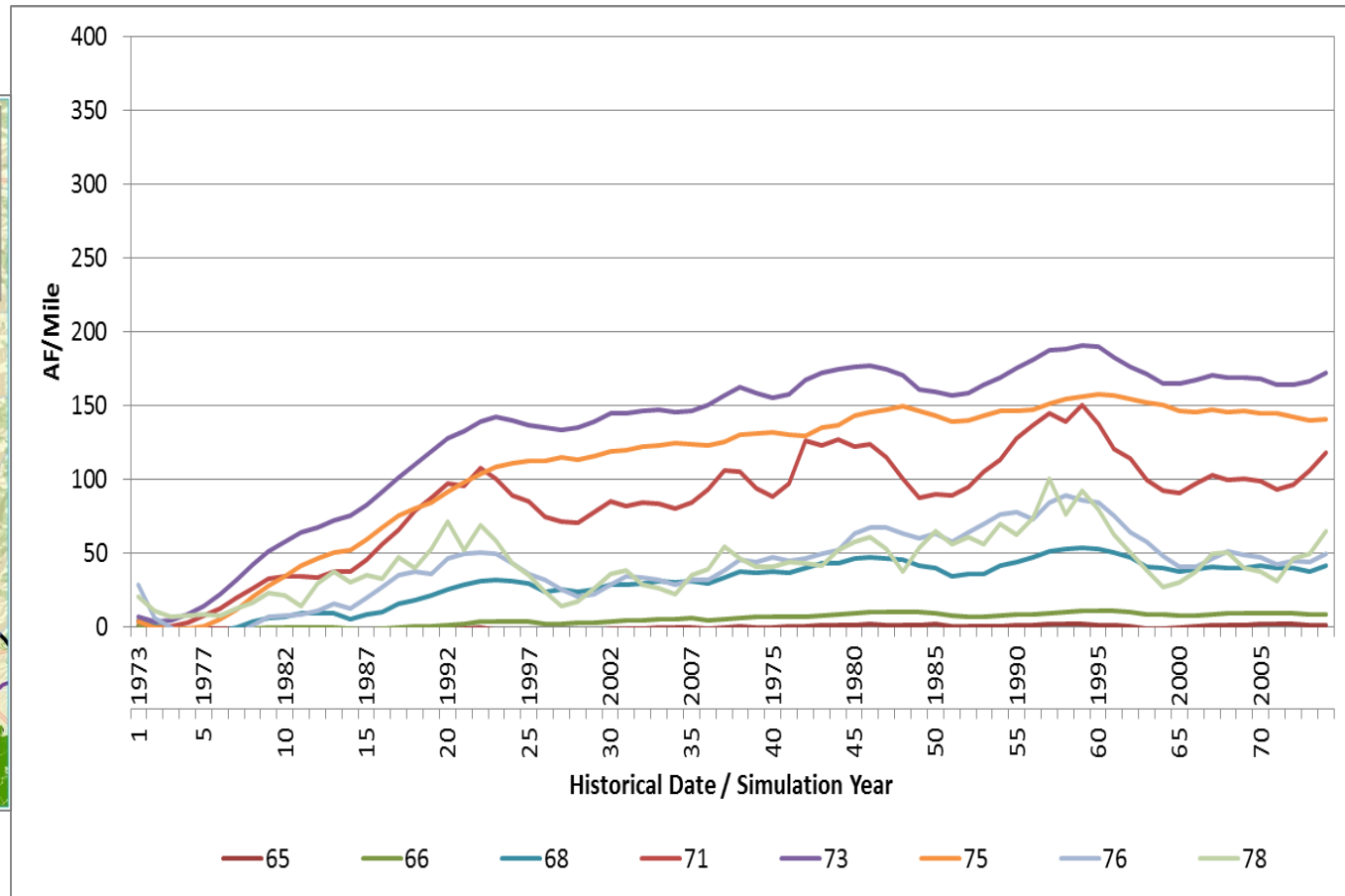
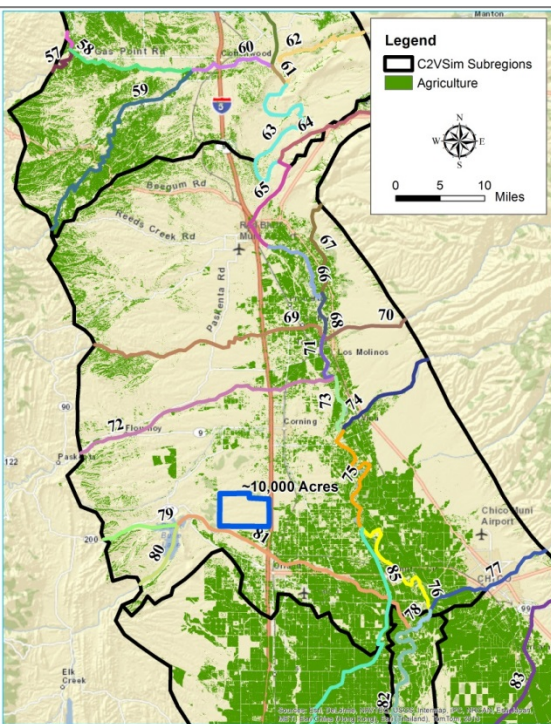
# Stream Reach Analysis



Reach 65 – Sacramento River  
Reach 66 – Sacramento River  
Reach 67 – Antelope Creek Group  
Reach 68 – Sacramento River  
Reach 69 – Elder Creek  
Reach 70 – Mill Creek  
Reach 71 – Sacramento River  
Reach 72 – Thomes Creek  
Reach 73 – Sacramento River  
Reach 74 – Deer Creek Group  
Reach 75 – Sacramento River  
Reach 76 – Sacramento River  
Reach 77 – Big Chico Creek  
Reach 78 – Sacramento River  
Reach 79 – Stoney Creek  
Reach 80 – Stoney Creek  
Reach 81 – Stoney Creek  
Reach 82 – Sacramento River

# Groundwater Gain From Stream

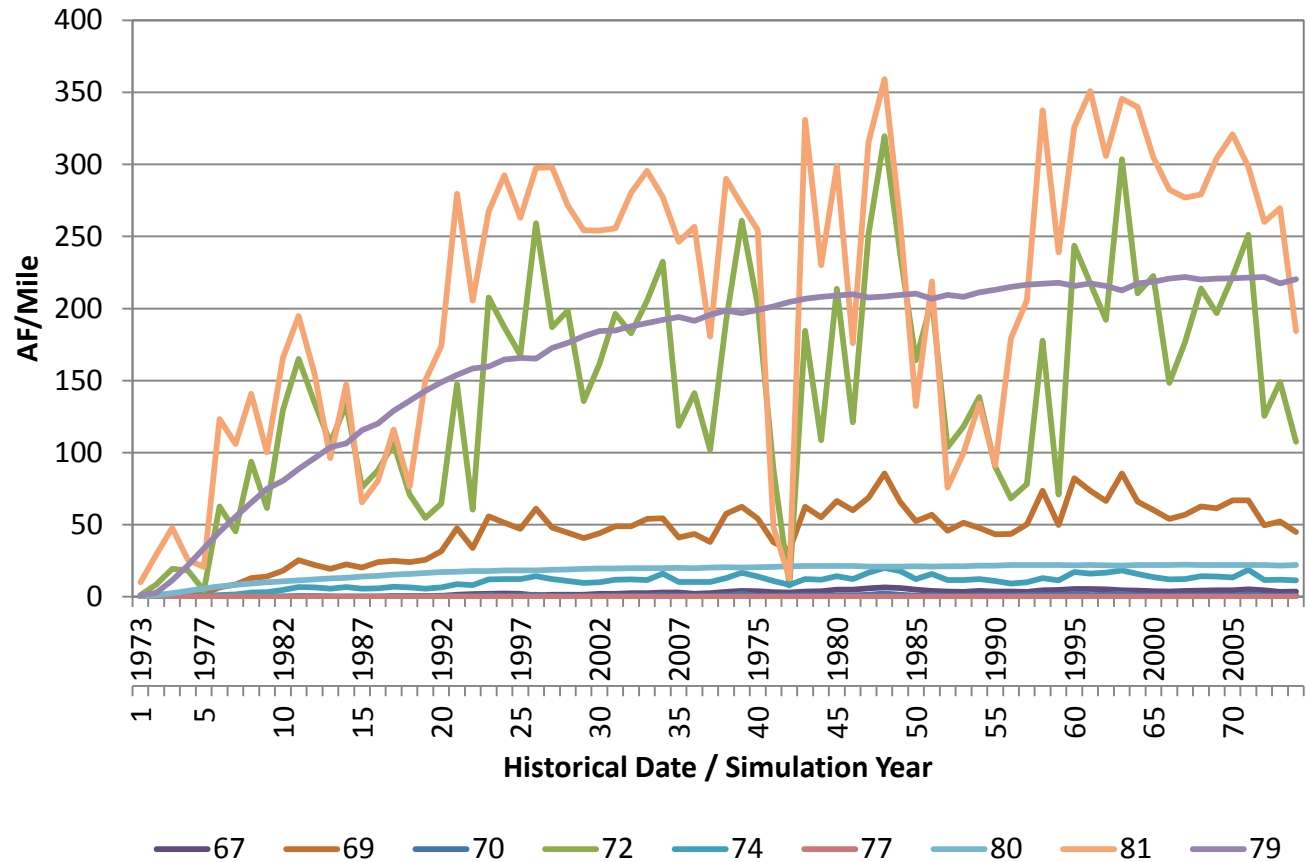
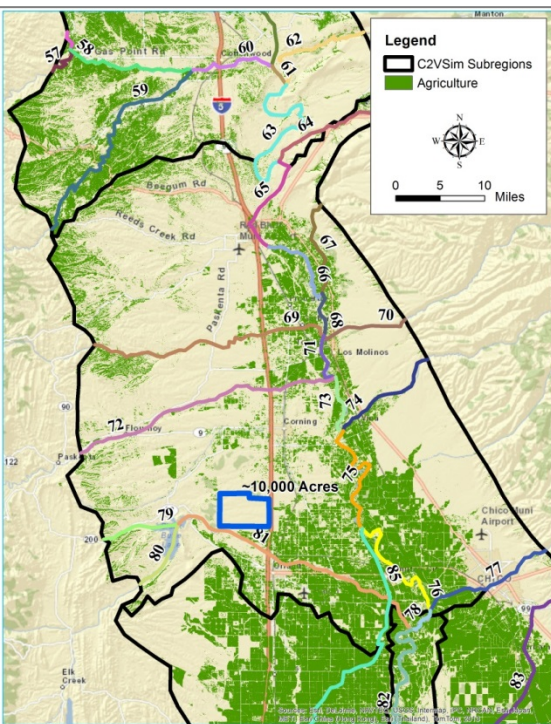
## (Sacramento River)





# Groundwater Gain From Stream

## (Sacramento River Tributaries)





## Scenario 2: Increased Irrigation Efficiency

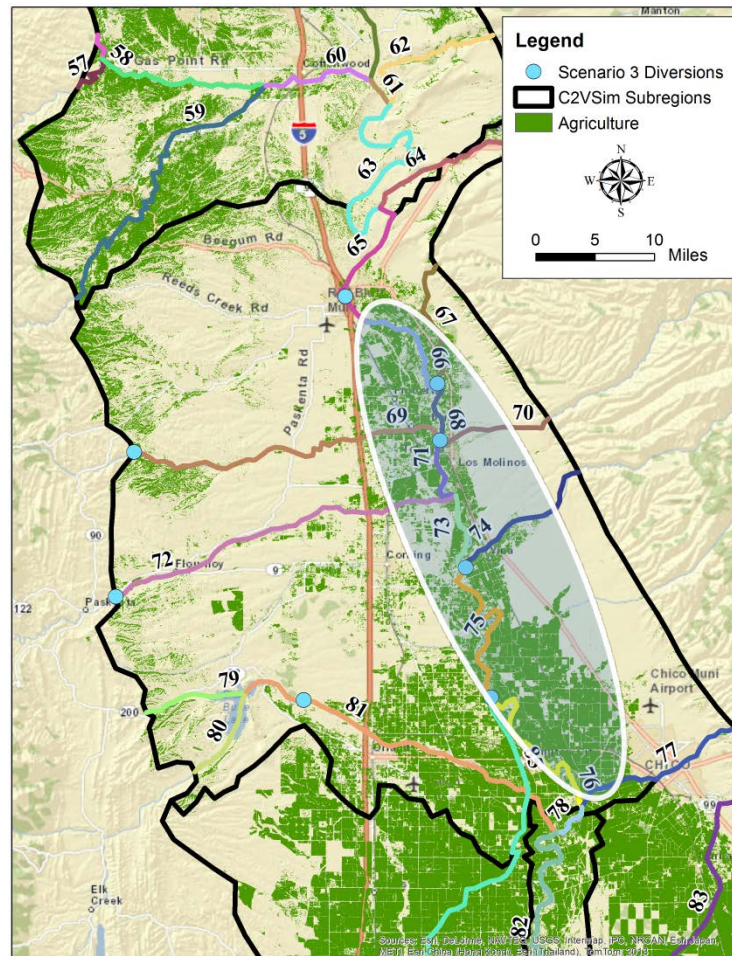
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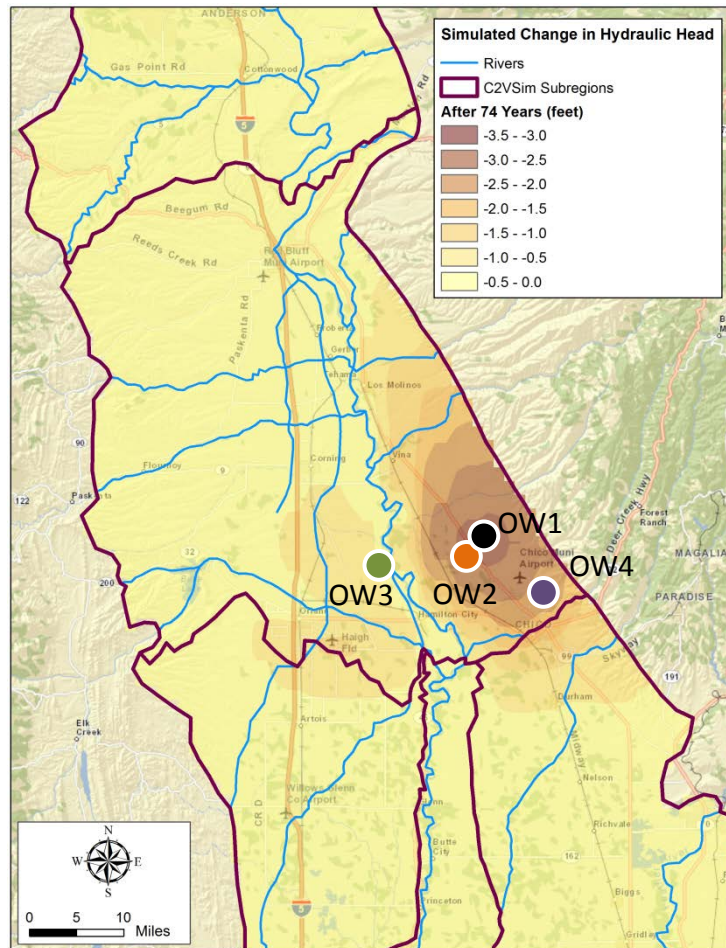
# Assumptions

- Improved Irrigation Efficiency Implemented on Roughly 100,000 Surface Irrigated acres
- Crop ET doesn't change (Same Crop, Irrigated for Same Yield)
- Improved Efficiency Translates into Reduced Surface Diversions
- Forgone Surface Diversions “Transferred” Downstream
- Selected Area
  - High potential for IE improvement
  - Majority of Ag area is tree crops
  - Large fraction of land irrigated from surface supplies
  - Increases to irrigation efficiency
    - Increased by 10 percentage points for all crops
    - Maximum IE cap: 87%
- All “saved water” left in stream eventually translates into
  - Reduced return flows
  - Reduced deep percolation to groundwater

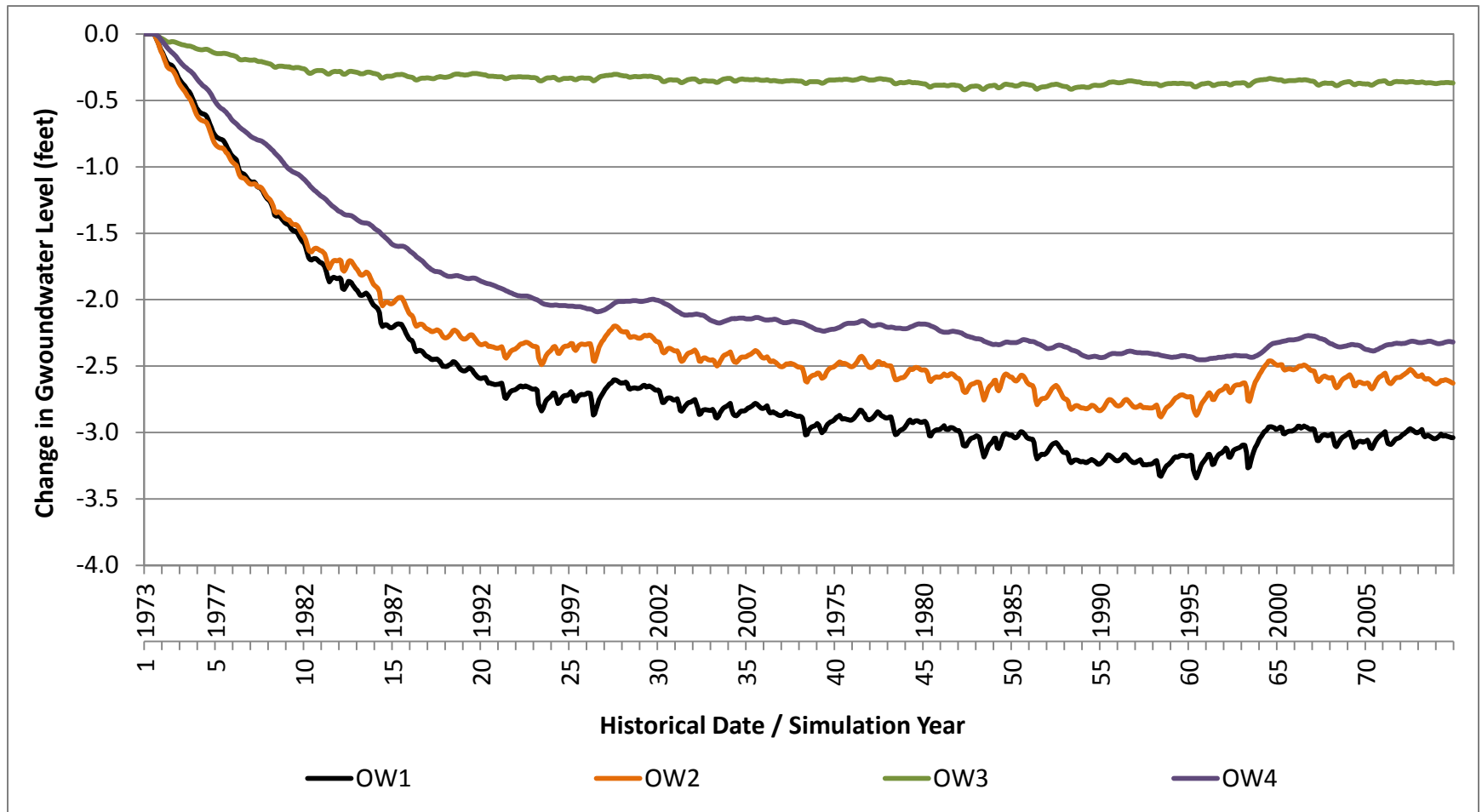
# Location



# Groundwater Level Analysis

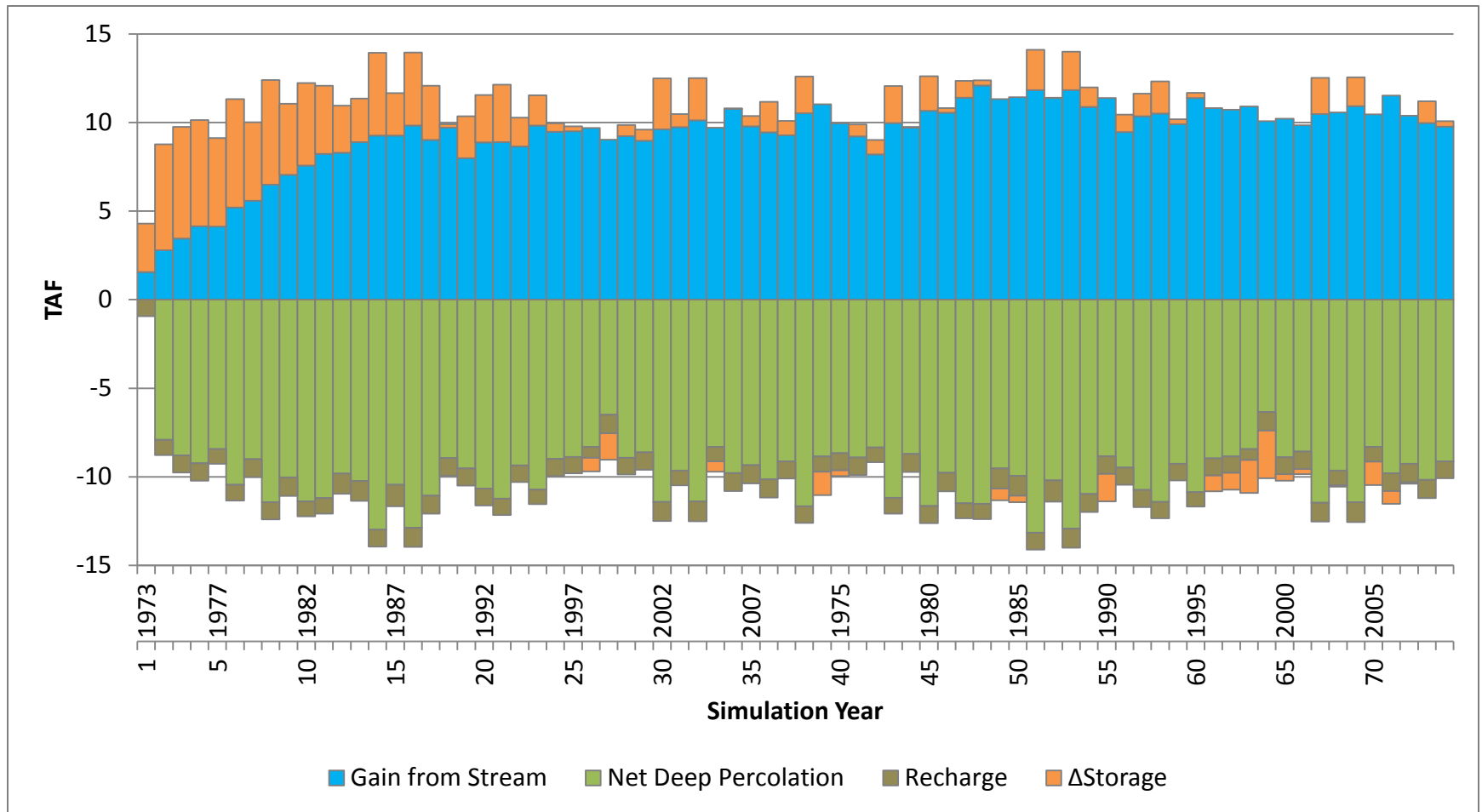


# Groundwater Level Analysis

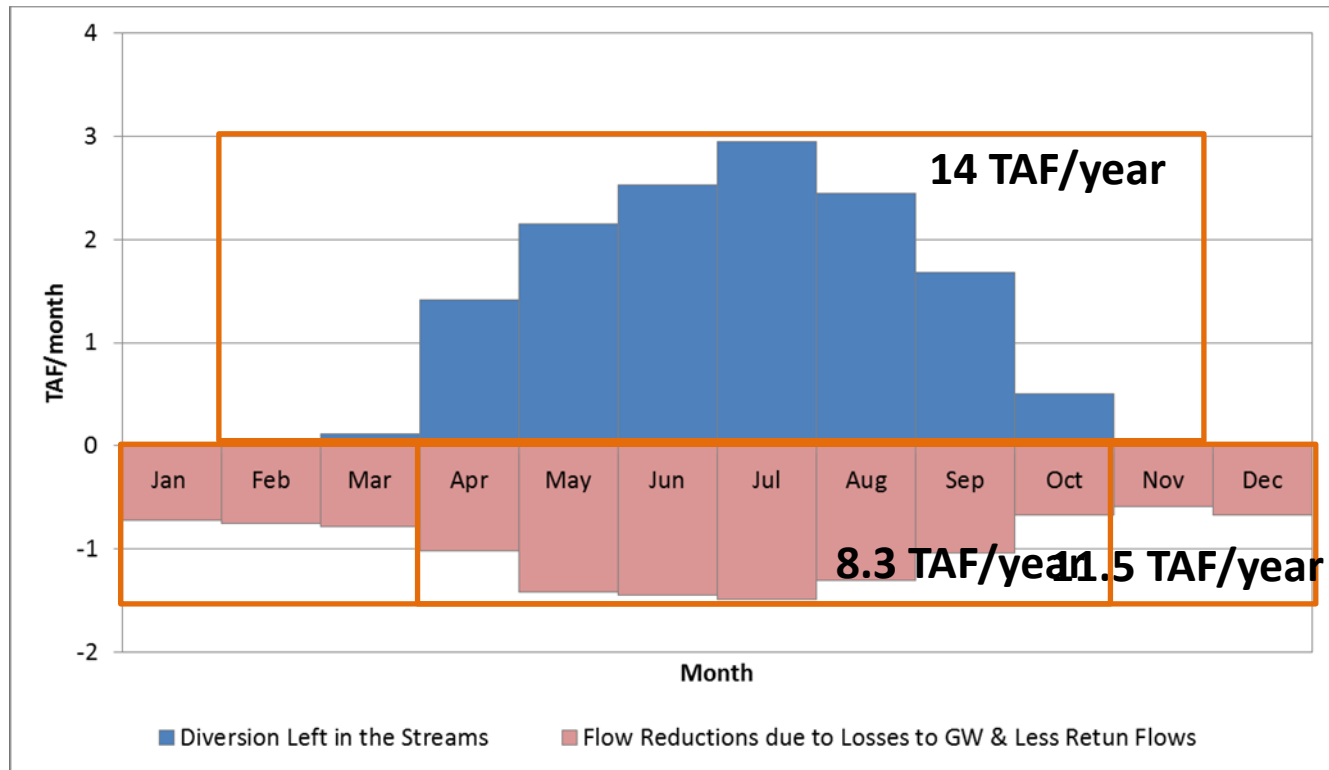




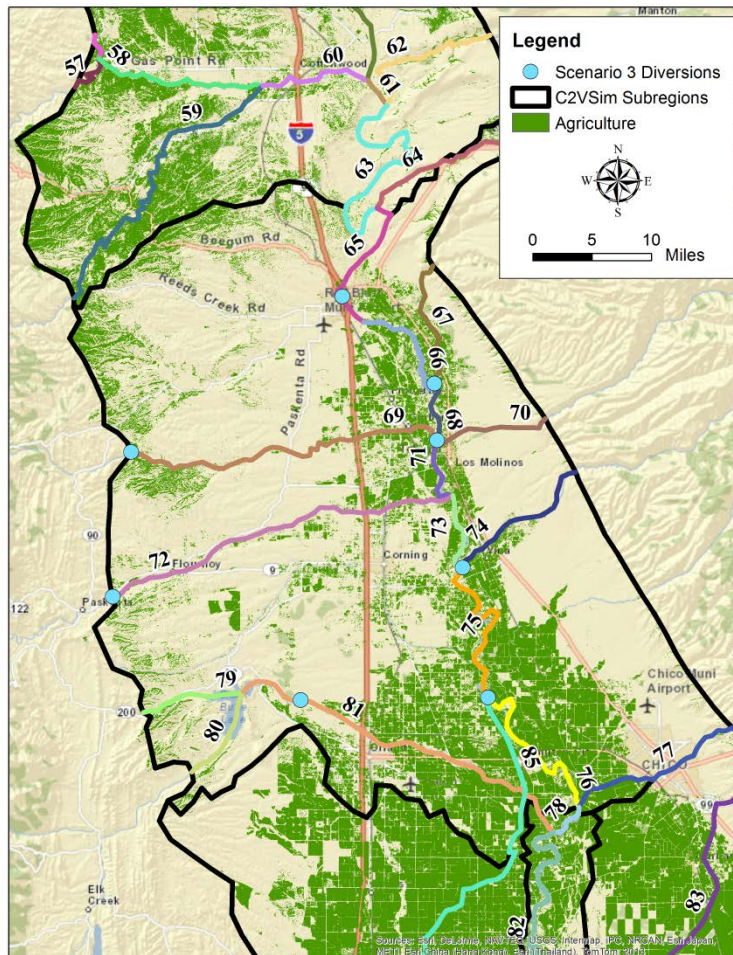
(Scenario – Baseline)



# Impacts on the Streamflows



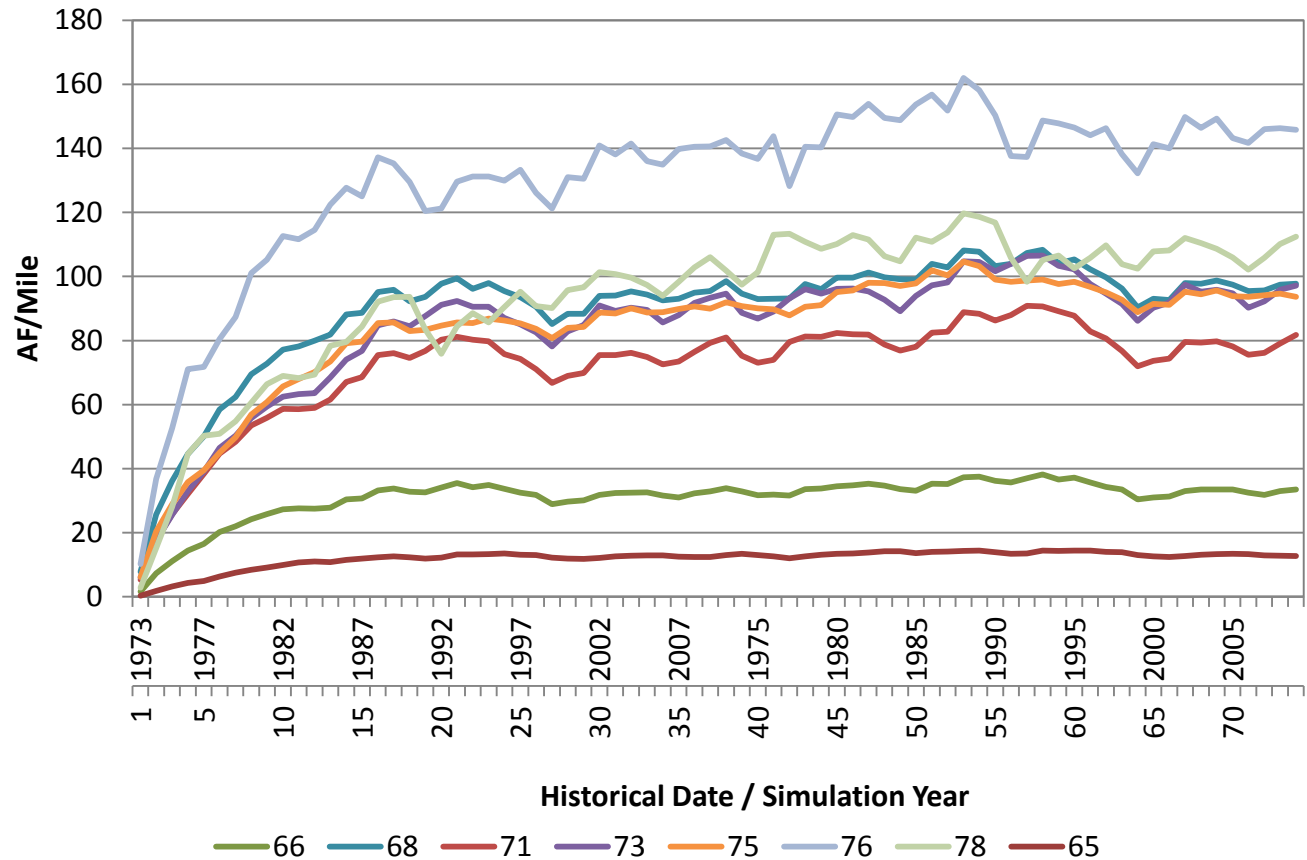
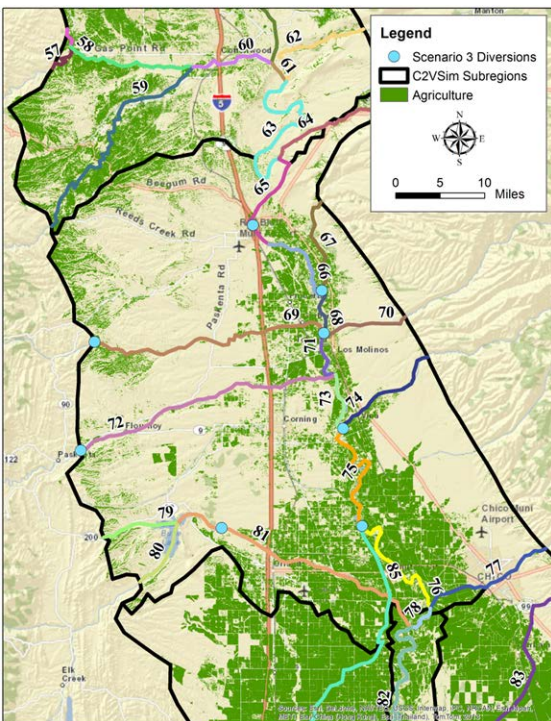
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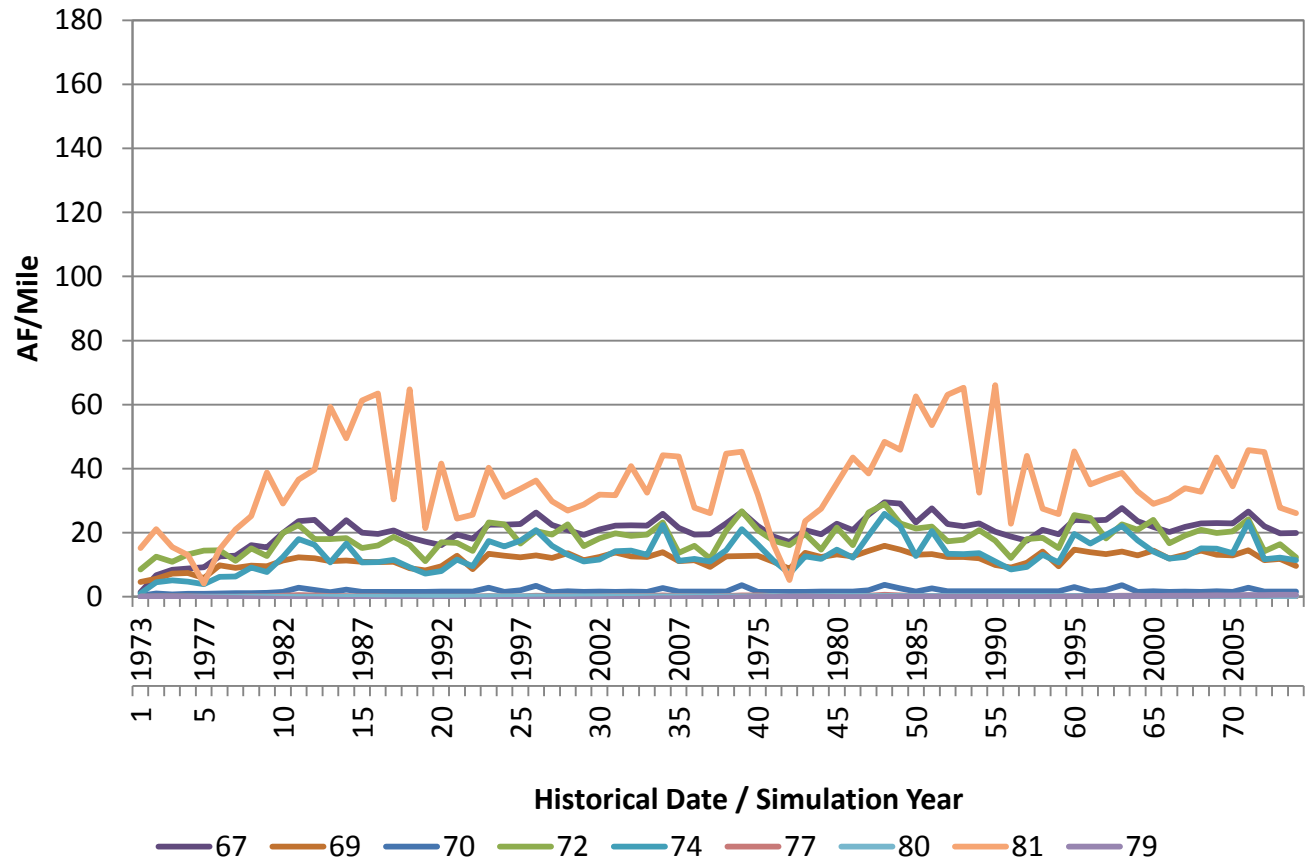
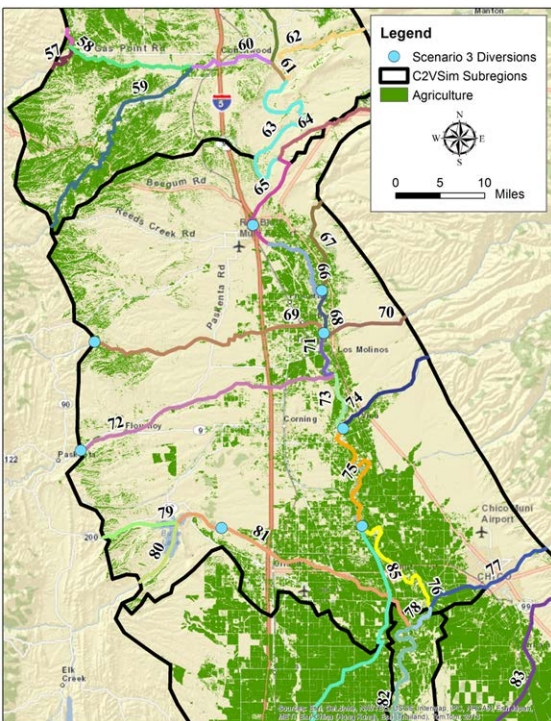
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## (Sacramento River)



# Groundwater Gain From Stream

## (Sacramento River Tributaries)





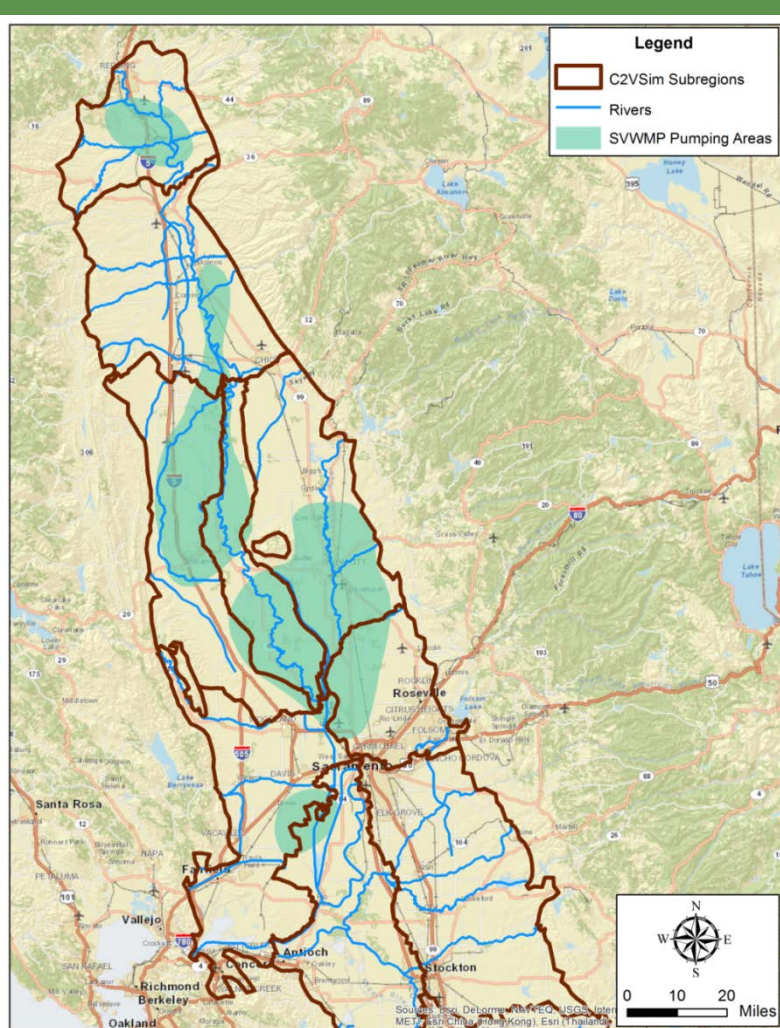
## Scenario 3: Groundwater Substitution

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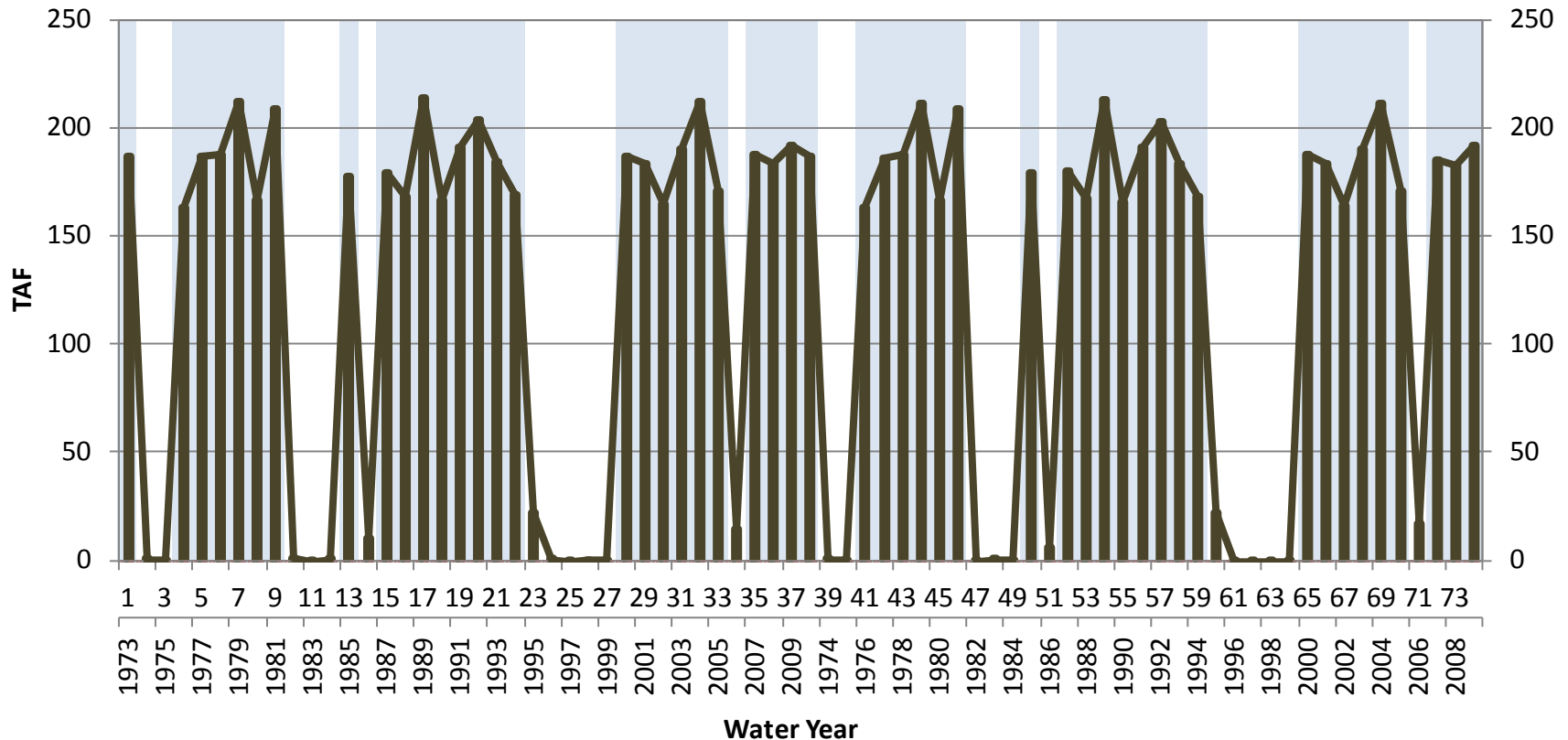
# Assumptions & Location



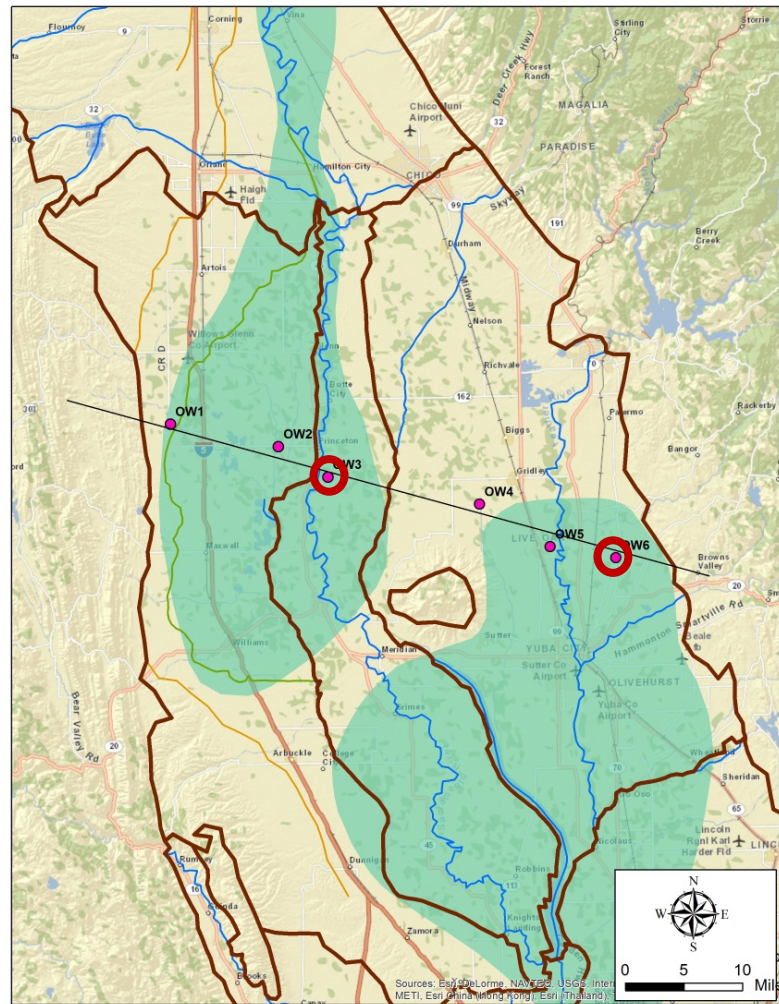
- Baseline Hydrology:
  - 1973- 2009 (Repeated x 2)
- Pump groundwater to replace surface water
- Project Pumping only in non-Wet years
- Project Pumping during June and October
- GW Facilities: 293 wells in 29 Irrigation Districts

# Transfer/Pumping in non-Wet years

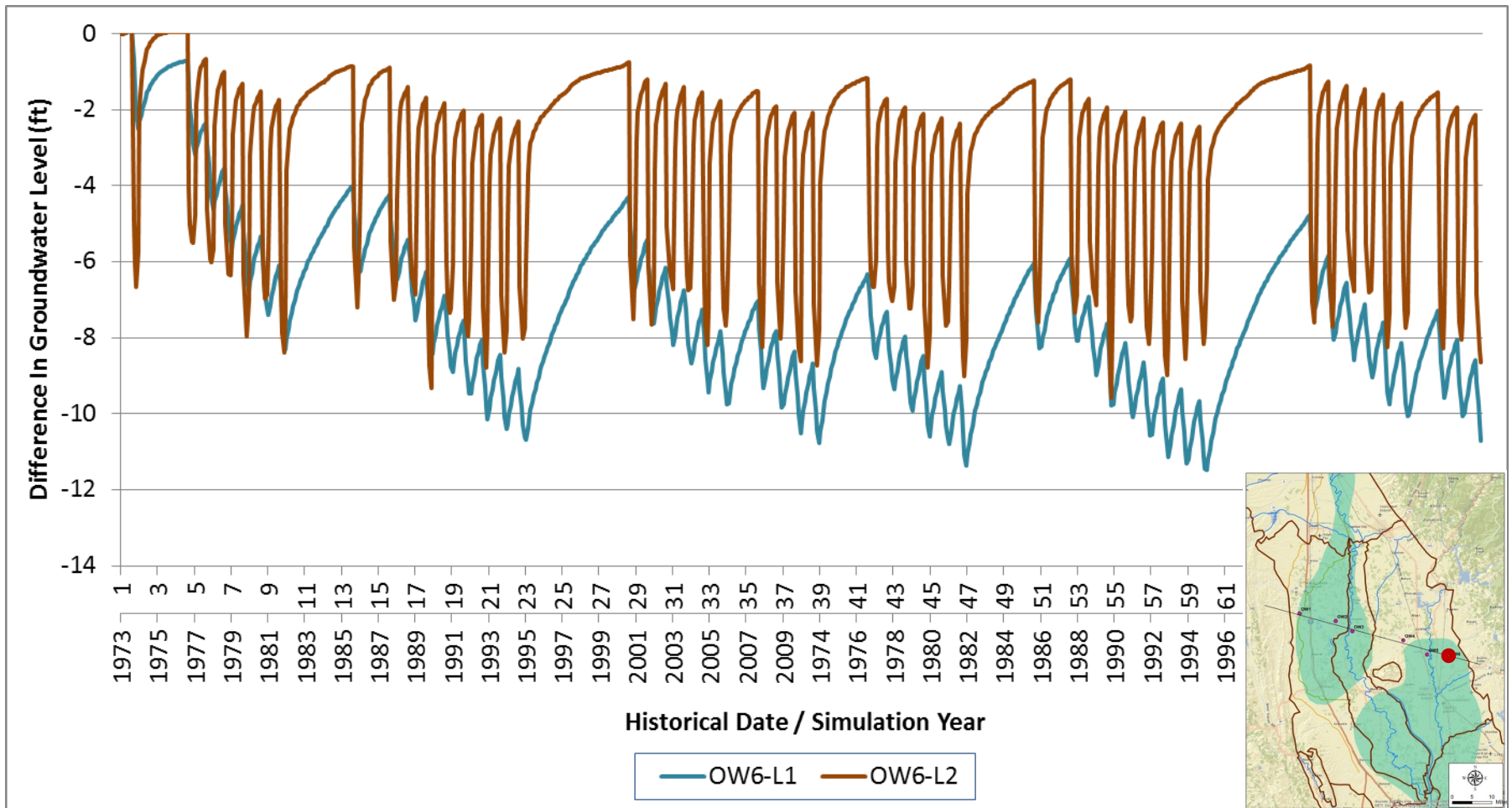
Average Project Pumping: 186,000 AFY



# Effects on GW Conditions

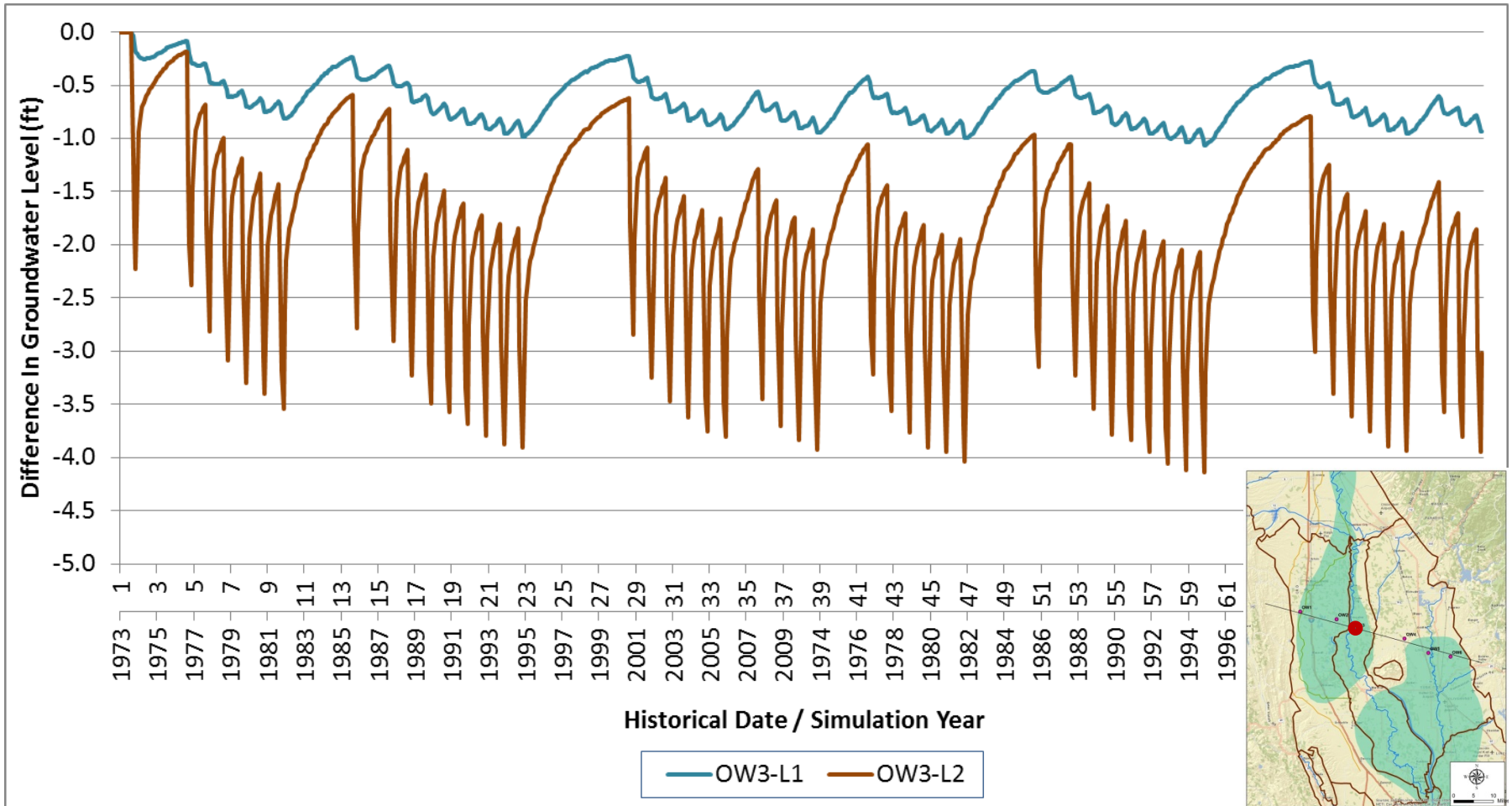


# GW Levels Away from River





# GW Levels close to Sacramento River



# Impacts on GW and Stream

